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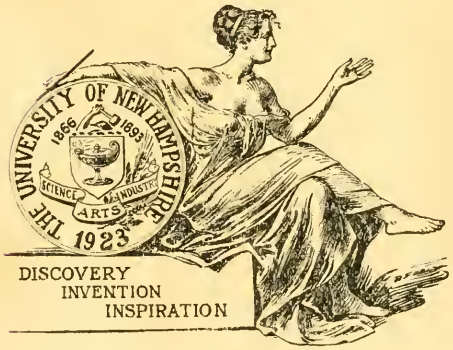

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NEW HAMPSHIRE

AGRICULTURAL EXPERIMENT STATION

PROGRESS OF AGRICULTURAL EXPERIMENTS—1926

A REPORT OF THE DIRECTOR OF THE NEW HAMPSHIRE AGRICULTURAL EXPERIMENT STATION FOR THE YEAR 1926, INCLUDING A FINANCIAL STATEMENT FOR THE FISCAL YEAR ENDING JUNE 30, 1926

THE UNIVERSITY OF NEW HAMPSHIRE

DURHAM, N. H.

TABLE OF CONTENTS

PAGE

Administrative Report 3

Publications 6

Report by Projects:

Animal Husbandry: Sheep Breeding; Nutrition Studies with Beef Steers 7

Dairy Cattle: Nutrition Studies with Dairy Cows; Physiological Studies of Dairy Cows 8

Dairy Products: Study of Some Important Factors Affecting Viscosity of Ice Cream Mix 9

Economic Entomology: European Corn Borer; The Stalk Borer; Black Flies; White Pine Weevil 9

Field Crops: Ensilage Variety Tests; Variety Test of Legumes; Sweet Corn Fertilization; Effect of Place on Potato Production; Spraying and Dusting Potatoes; Effect of Differently Cut Potato Seed and Siccatives; Potash Tests on Potatoes; Fertilizer Placement Tests on Potatoes; Value of Manure for Potatoes; Effect of Nature of Seed Piece; Spraying Mustard 11

Forestry: Forest Plots 17

Horticulture: Fruit Bud Formation; Relation of Composition to Performance of Fruit Spurs; Late Fertilizer Applications and Fruit Bud Formation; Winter Injury of Apples; Pruning Experiment with Apples; Fertility in the Peach Orchard; Variety Test of Apples, Pears and Plums; Effect of Fertilizer on Strawberries; Tomato Variety Tests; Effect of Phosphorus on Cabbage; Cabbage Fertilizer Experiment 18

Plant Pathology: Effect of Fungicides on Plants; Apple Scab; Bitter-Pit of Apple 35

Rural Economics: State-Wide Consumption Survey; Cost of Fruit Study; Commercial Apple Orchard Survey 36

Rural Electricity 37

Soils: Soil Fertility Studies: Effect of Manure, Fertilizers and Lime on Worn-Out Hay Lands; Legume Growing on Worn-Out Land; Effect of Green Manure and Fertilizer on Worn-Out Hay Land; Crop Rotation System; Pasture Improvement through Sweet Clover 37

Testing and Inspection Service: Feeding Stuffs; Fertilizer; Seeds; Advanced Registry Tests; Post-Mortem Examinations; White Diarrhea Tests; Potato Seed Certification; Miscellaneous Tests 40

Veterinary Medicine: Paralysis in Chickens; Testing Pullets for White Diarrhea 41

Financial Statement 44

PROGRESS OF AGRICULTURAL EXPERIMENTS, 1926

ANNUAL REPORT OF THE DIRECTOR OF THE NEW HAMPSHIRE AGRICULTURAL EXPERIMENT STATION

The broadening out of research work into the field of agricultural economics has perhaps been the outstanding feature of the New Hampshire Agricultural Experiment Station's first year of additional help from the Purnell Fund. This appropriation, made available by act of Congress in 1925, has for the first time made it possible for the Station to investigate such problems as the economic balance between production and consumption of food stuffs grown in the State, the trends of production, the costs of growing various crops under New Hampshire conditions, and the important marketing problems which during recent years have been of more and more concern to people interested in the agricultural welfare of the State.

As a ground work for investigation of this type it was considered advisable to concentrate during the past year on the completion of an economic survey which we believe has the distinction of being the first state-wide survey of its kind that has been made in this country. The study reached into every section of New Hampshire, securing records from practically every retail store as well as a large per cent of the hotels and camps. The results have already been set forth in Station Bulletin No. 222, "Can New Hampshire Produce More of What She Eats?" The study has raised several interesting questions; for example, it was found that over 300,000 bushels of potatoes, nearly half of those marketed in the state, are shipped in during the competing season when local grown potatoes could be sold. Whether certain types of farms cannot efficiently produce this crop by the use of improved methods in competition with outside areas, is one of the questions which we are now pursuing. Another important problem raised by the study deals with the possibility of producing poultry and vegetables for the White Mountain hotel trade. With many crops it was surprising to find how nearly the demand is at present supplied by locally grown products. The importance of knowing the facts regarding these questions is obvious. It is only by patient research that a true picture of the situation as regards production and marketing is possible.

During recent years it has been possible for the Station to carry on more of its investigations throughout the state as a whole. So much of the research work has been of necessity conducted at headquarters in Durham that many people have perhaps not realized the state-wide significance of the work; but there is now a noticeable increase in the amount of territory over which it spreads. The investigators conducting the economic survey went into most of even the small towns in the State. The study of the commercial apple industry required personal visits to over 800 orchards in 140 towns, including, it is be-

lieved, every commercial orchard in New Hampshire. The seven farms being studied in the rural electricity project are located in Grafton, Merrimack, Strafford and Rockingham Counties, and were chosen to represent various types of farm enterprises.

It is particularly important that soil fertility studies should represent farm conditions in general throughout the State, and it is in this work that local experimentation at Durham has been weakened in the past because of soil conditions. The establishment of a series of experimental plots on representative soil areas at Greenland and Boscawen during the past year has been a marked step in advance and should furnish us greatly needed information regarding the problem of restoring worn-out hay lands. This is perhaps the most important problem facing New Hampshire agriculture today, and it is believed that the investigation will be fundamental to future progress.

In similar fashion the studies of potato diseases have made it advisable to conduct work in the northern part of the State as well as in the southern counties. In the past few years observations in this field have been made at a number of points, notably at Colebrook and East Kingston. Studies of apple pests and diseases have been made at New Boston, Contoocook and Greenland. Observations of black flies have been extended over a long period by the station at 88 different points in the State, a large part of them in the northern counties. Soil tests have been made covering a large number of farms in all sections. In these and other ways the work of the Station has been made increasingly free from geographical limitations and more adequately represents the agriculture of the state as a whole.

The extension of the nutrition investigation to dairy cattle has been marked by a signal advance in technique which has made possible a more accurate study of basal metabolism than has perhaps ever before been possible with the apparatus available. Requests for details of this work have already been received from a number of European investigators.

Definite figures on the costs of electrical power under farm conditions are being secured as a result of our rural electrical project; and from now on we may expect a series of fairly definite answers to questions regarding the practicability of different types of equipment. The work has attracted attention throughout the eastern States through its cooperative association with the National Committee on the Relation of Electricity to Agriculture.

While these advances of the work during the past year have been most gratifying, it should be pointed out that they have been made possible almost entirely through the use of federal and other funds not of state sources. The state funds represent only about 8% of the appropriations going into research work at the station during the past year; whereas in the country as a whole the average state fund represented approximately 70% of the official appropriations. Only five stations in the country had state appropriations of less than $10,000; New Hampshire's is only $4500. Since much of the necessary work of the Station is of the nature of a special state service and cannot be properly handled under federal funds, the state needs of the station should be more adequately met. In this connection, Dr. E. W. Allen, chief

of the Office of Experiment Stations, U. S. Department of Agriculture, says in a paper presented before the Association of Land-Grant Colleges:

"The responsibilities of the States in relation to this supplementary legislation have been referred to quite definitely on a number of occasions, but in the interest of clear understanding it may be desirable to again call attention to this matter as having a fundamental bearing on the success of the enlarged enterprise.

"The Purnell Act, like its predecessors, is not conditioned on similar contributions from the States. In this respect it will be recognized as a departure from recent legislation in which the Federal Government has joined with the States in promoting various measures of public interest. The advisability of incorporating such a contributory provision was considered at the time the legislation was being framed and again when it was being advocated in Congress; but, on the strength of the arguments presented by representatives of the Association of Land-Grant Colleges and the record of nearly forty years, such a requirement was omitted from the Act as passed. The absence of it will evidently make it important to avoid any seeming departure from the tacit understanding implied.

"In his address at the Conference of Agricultural Colleges and Experiment Stations at St. Louis in 1925, soon after the passage of the Purnell Act, the Secretary of Agriculture called attention to the fact that in effect the maintenance of experiment stations 'always has been a cooperative enterprise between the Federal Government and the States. The Hatch Act, which supplied the initiative for the national system, did not undertake to carry the whole burden. It was designed, as the opening sentence stated, "to aid" in attaining the objects sought in the establishment of these institutions.' He pointed out that 'in advocating this latest legislation much emphasis was laid on what the States are now doing, and on the fact that it was not designed to relieve them but rather to stimulate and further extend their efforts.' And again, that the Purnell Act 'is not designed to transfer these obligations to the Federal Government, but to enable the latter to join more liberally with the States in the maintenance of investigation at these institutions. It is the confident expectation, therefore, that the individual States will continue to bear their part.' "

Changes in Personnel

In order to initiate the work in agricultural economics with an eye to actual needs and conditions in the state, Mr. H. C. Woodworth, extension farm management specialist, was placed in charge of several of the projects in this field at the beginning of the year. Mr. L. B. Lincoln was secured to assist in the state-wide economic survey and resigned at the close of this work. Dr. Max F. Abell of Massachusetts Agricultural College has been appointed assistant agricultural economist. Miss Mary E. A. Pillsbury has been appointed specialist in home economics to take charge of the investigations in human nutrition. Mr. G. P. Percival has been appointed assistant chemist to take care of the increased chemical assistance necessary in the soil fertility work and other projects. Dr. F. R. Clark, assistant botanist, resigned

at the close of the fiscal year and his place has been taken by Mr. S. Dunn of Iowa State College. Mr. S. W. Wentworth, assistant horticulturist, is on leave of absence for the year and his place is being taken by Dr. L. P. Latimer of California. Mr. L. R. Tucker of Illinois has been appointed graduate assistant in horticulture.

Improvements

Development of the nutrition laboratory to take care of the work with dairy cattle was made at the beginning of the fiscal year. The laboratory is now being further extended in order to accommodate the work in human nutrition.

Publications

The following publications have been issued during the year: Technical Bulletin 29, "Some Chemical Constituents of Fruit Spurs Associated with Blossom Bud Formation in the Baldwin Apple", by H. R. Kraybill, G. F. Potter, S. W. Wentworth, P. T. Blood, and J. T. Sullivan; Technical Bulletin 30, "The European Corn Borer—The Relation of the Larvæ to Submergence," by Milton F. Crowell; Station Bulletin 218, "Inspection of Commercial Feeding-Stuffs, 1925" by T. G. Phillips, T. O. Smith, A. W. Petre; Station Bulletin 219, "Inspection of Commercial Fertilizers for 1925" by T. G. Phillips, T. O. Smith and A. W. Petre; Station Bulletin 220, "Results of Seed Tests for 1925" by M. G. Eastman; Station Bulletin 221, "Progress of Agricultural Experiments—1925", by J. C. Kendall; Station Bulletin 222, "Can New Hampshire Produce More of What She Eats?" by H. C. Woodworth, L. B. Lincoln, and H. I. Richards. In addition to these bulletins several extension publications have been prepared by members of the station staff during the year.

News of the work of the Experiment Station has been sent to various papers through the series of news letters; and members of the staff have contributed many articles during the past year to the semi-weekly farm page conducted by the *Manchester Union*. A series of special stories dealing with the economic survey have been sent weekly for several months covering various commodities to the weekly papers of the state and have been quite generally used. The cooperation of the press in spreading news of the results of the research work is greatly appreciated.

Other State Service Work

In addition to the regular testing work, analyses of soils, feeding stuffs, fertilizers, post-mortem examinations, seed tests, etc., a large amount of correspondence has been handled by members of the staff, most of it arising from farm problems throughout the state. Many lectures and talks have been given; judging assistance has been extended to fairs; personal advice has been given to many visitors and on many farms; and in general the staff has assisted to the best of its ability to further agricultural progress in New Hampshire.

REPORT BY PROJECTS

ANIMAL HUSBANDRY

Sheep Breeding—(*Adams Fund*)

Since the object of this project is the final establishment of a strain of sheep with good weight of lambs, good fleece, and possessing four functional nipples, a high milk yield in ewes, and a high twinning tendency, it is obvious that progress is necessarily slow, and but few changes and results can be reported from year to year. No special tests are being made regarding the milk yield of ewes. The animals are being classed simply as (1) good, (2) fair, and (3) poor milkers based on the knowledge and observations of the shepherd. The estimates are, however, further checked by the rate of increase in weight of suckling lambs. The results obtained in twinning and in growth or weight of lambs indicate a satisfactory progress toward the end in view. Fifty-four per cent of the litters, that is, somewhat over 70 per cent of all lambs born, were twins. The rate of growth also was satisfactory, the average weight at 3½ months being over 60 pounds per head. It seems essential to proceed along these lines for some years and develop more highly the separate traits possessed by different groups before they are crossed finally to merge into a single group.

The work is in charge of E. G. Ritzman, who has had the benefit of the advice and cooperation of C. B. Davenport, director of the Laboratory of Experimental Evolution of the Carnegie Institution of Washington. Messrs. Davenport and Ritzman are now reporting in bulletin form on the results of the breeding work as it affects wool characteristics.

Nutrition Studies with Beef Steers—(*Adams Fund—in Cooperation with the Carnegie Institution of Washington*)

The change in technique made during the previous year (1924-1925) from the two-hour respiration experiments to continuous four-day experiments together with the new apparatus for determining methane production made it possible to take up for the first time problems important in the study of CO_2 production. These were primarily the production of methane during feeding and during fasting, and also on rations of timothy hay only and on rations of timothy hay with linseed oil meal. A device was arranged in the respiration chamber indicating by an alarm bell when the animal changed position from standing to lying and reverse so that the total time spent could be accounted for and a separate collection of CO_2 could be made for standing and lying.

In the main the same principle of procedure was followed in the respiration experiments as during the preceding year; namely, of studying the first two days on the same feed level, with the same environmental temperature on which the animals had been maintained for at least two weeks previous to the experiment, and proceeding the last two days without feed.

One five-day fasting respiration experiment was also made with each steer to study the decline in methane production. Much of this work has been necessary for the best utilization of the data on fasting which have been compiled for publication and which have now gone to press. This publication, entitled "The Metabolism of the Fasting Steer", will appear as Publication No. 377 of the monograph series of the Carnegie Institution of Washington.

The Station has had the good fortune to have the continued active participation of F. G. Benedict of the Carnegie Institution on this work, which has been under the local direction of E. G. Ritzman.

DAIRY CATTLE

Nutrition Studies with Dairy Cows—*(Purnell Fund—in Cooperation with the Carnegie Institution of Washington)*

In beginning this work with dairy cows it was deemed advisable by Messrs. Benedict and Ritzman to start with a study of maintenance requirements which have long been a subject of controversy. Since the standards of maintenance feeding now in use vary materially, it seems highly desirable to determine first by use of the respiration chamber, the daily heat production of these cows when fed rations based on maintenance determined by live-weight experiments. Two kinds of feeding were used, namely, alfalfa hay and timothy hay with linseed oil meal, both rations having previously served as a basis for determination of maintenance requirements.

The technique followed was much the same as with steers. The animals were kept under constant conditions of feed and environmental temperature for at least three weeks prior to a respiration experiment and the same conditions were maintained through the experiment except that feed was withheld during the last two days.

As the mechanical device for separating the collection of urine and feces from cows was not perfected to operate with a sufficient degree of accuracy until toward spring, few samples of urine and feces were obtained for separate analysis. This work will be repeated along much the same lines during the coming year.

A Physiological Study of Dairy Cows—*(Purnell Fund)*

The data secured during the year by J. M. Fuller indicate that the respiration rates of cows under normal herd conditions may vary from 12 to 58 per minute and that pulse rates of cows under normal herd conditions may vary from 52 to 88 per minute. A three-days' continuous observation of 38 cows showed on the average approximately 50% of the time was spent standing and 50% lying. Variations ranged from 34.8% standing to 63.35% standing.

A three-day observation, made on water consumption by cows in the University herd, showed a minimum consumed by any one cow through a 24-hour period of 18 pounds and a maximum of about 233¾ pounds.

The amount of urination and defectation during a three day period was noted. The maximum number of urinations and defectations ran as high as 20 per day with some cows.

A number of observations were also made to ascertain skin temperature of cows in the milking herd.

DAIRY PRODUCTS

A Study of Some Important Factors Affecting Viscosity of Ice Cream Mix—(*Purnell Fund*)

The influence of certain factors on the viscosity of the ice cream mix and the relation of viscosity to whipping quality were studied by H. F. DePew, who notes the following results: 1. Homogenization greatly increased the viscosity of the mix; the higher the homogenization pressure, the greater the viscosity. 2. Gelatine increased the viscosity of the mix. 3. Pasteurization of the mix at 150° F. for 20 minutes and homogenization at this temperature produced greater viscosity than when the mix was cooled to 110° before homogenizing. 4. Viscosity was increased by aging the mix at temperatures between 32° and 40°. 5. A mix containing sweetened condensed milk showed greater viscosity than one in which skim milk powder was substituted for condensed skim milk. 6. A longer period of freezing was necessary to obtain the same overrun when a very viscous mix was frozen as compared with one with less viscosity.

ECONOMIC ENTOMOLOGY

European Corn Borer—(*Adams Fund*)

The season has been one of unusual interest in the life history studies of the European corn borer. In 1925 the first over-wintering larva to enter the pupal stage pupated on May 18. This was very late and should be compared with April 28 of the preceding year. In 1926 the season was late again, and the date of first pupation was again May 18; but as the spring continued, the retarded state of insect life became more and more evident. This effect persisted throughout the season and grew even more emphasized as the summer drew to a close.

For example, the first eggs laid by adults of the over-wintering generation of the current year were found June 14 last year, but not until June 25 this year. The first larva of the succeeding generation hatched June 22 last year, but not until July 3 this year. Pupation of the larvæ from this generation began July 21 last year but not until August 8 this year. Whereas the first adult of the corresponding generation emerged Aug. 5 last year, the first adult was not found until Aug. 19 this year. And finally, the first larva of the succeeding generation hatched Aug. 19 last year, but not until Sept. 12 this year.

As a net result of this situation it now appears unlikely that European corn borer larvæ of the generation just described will reach sufficient size to pass the coming winter successfully. Larvæ of the earlier generation will over-winter no doubt in the normal manner. As in other seasons there are larvæ of the early generation that enter hibernation at once and do not transform until the following season.

Whether because of a season clearly unfavorable to them or not, the European corn borer has not reached intense infestation in New Hampshire that we can discover, reports W. C. O'Kane, who has charge of this project. The insect is very widely distributed, but at the same time it is not plentiful in the sense that it has reached badly injurious numbers in any one place.

Accumulated data on its life history will shortly be published as a progress report.

Another phase of the investigation has had to do with the spiracular closing apparatus and its performance at various stages of hibernation of the larva. A critical study of the apparatus and its performance was made, including its anatomy, its relation to the tracheal system, and its status, both as the larva is approaching hibernation in the fall and as it is emerging from hibernation in the spring. Interesting results were secured, and these have been brought together by M. F. Crowell in Technical Bulletin 30.

The Stalk Borer—(*Hatch Fund*)

The effect of the unusual season has not been as marked on the stalk borer as on the European corn borer. Dates for transformations have been later than those of last year, however, reports P. R. Lowry; for example, hatching of over-wintering eggs began May 26 this year as compared with May 18 last year. Pupation began Aug. 10 as compared with Aug. 4, and the first adults emerged Sept. 10 as compared with Sept. 1 last year.

A further study of parasites has been made. The species of *Diptera* that was found last year is again plentiful, and is the most marked natural enemy of this insect under New Hampshire conditions. A second species of *Hymenoptera* has been found this year, making two in all. Its identity will be determined when the adults have been secured.

Black Flies—(*Hatch Fund*)

The study of black flies, including ecological data secured at eighty-eight observation points and extending over a long period, as well as further experiments in control, was brought to a close in the year just passed. The material has been tabulated and prepared for publication as Technical Bulletin 32.

White Pine Weevil—(*Purnell Fund*)

Life history studies of the white pine weevil have been in hand for the past year. Interesting facts have been secured as to the habits of the weevils, their manner of gaining access to the leader, the process of egg-laying, the developmental dates of the larvæ, and the hibernation habits of the adults. Specimens of a related species have been found attacking the roots of small stunted pines.

This work is planned to continue for the coming season and to include a study of parasites and an investigation of the performance of weevils under various conditions as to pure and mixed stands.

FIELD CROPS

Ensilage Variety Tests—(*Hatch Fund*)

The ensilage from nine varieties of corn grown and reported a year ago by F. W. Taylor was analyzed in March, 1926, by the chemical laboratory. Table 1 shows the yield per acre together with the results of the chemical analyses of these nine silages:

TABLE I—*Yields and analyses of ensilage plots*

Variety	Tons per acre	Per cent protein	Per cent carbonyl	Per cent fat	Per cent crude fibre	Per cent ash
Eureka	13.85	1.48	14.77	.41	6.39	1.23
Pride of the North	9.65	1.75	14.69	.68	5.23	.87
New Hampshire 500	7.95	1.62	15.12	.74	4.94	.41
Minnesota 13	8.69	1.28	15.21	.72	4.73	.78
King of the Earliest	8.91	1.29	15.20	.74	5.24	.75
Leaming	11.07	1.05	15.39	.60	5.46	.94
Improved Leaming	11.19	1.29	15.22	.57	6.06	.90
Luce's Favorite	9.57	1.63	14.95	.53	5.32	.89
Sanford White	7.77	1.30	15.15	.54	5.20	.98

Variety Tests of Legumes—(*Hatch Fund*)

A half-acre of the Heater Lot on the college farm was laid off into eightieth-acre plots in the spring of 1926 and seeded to alfalfa, sweet clover, and red clover with barley as a nurse crop. Different varieties and strains of these legumes from different sources were planted to secure data on their comparative adaptability to this climate.

Sweet Corn Fertilization—(*Hatch Fund*)

This project was conducted by F. S. Prince and J. R. Hepler, on plots 20 x 50 located on the Horticultural Farm. The treatments were duplicated three times, and one row of corn around the plots was discarded in order to avoid any overlapping of fertilizer applications. The corn was planted May 25 and harvested September 5 to 10. Table II shows the treatment and yields of both corn and stover.

Effect of Place on Potato Production—(*Purnell Fund*)

Previous experiments on the effect of early harvesting on freedom of potatoes from degeneration diseases and productivity were continued by O. Butler. Green Mountains, grown at East Kingston in 1922, were dug after 90 days and planted in 1923. In 1923 the stock was again harvested after 90 days' growth and planted in 1924. In 1924 the stock was harvested after it had grown 90 days, 100 days, 124

TABLE II—*Yields of sweet corn fertilization plots*

Plot	Treatment	Yield of ears in pounds per acre	Yield of stover in tons per acre
1	15 loads manure.....check	9100	9.19
2	30 loads manure.....	9801	10.81
3	15 loads manure 400 pounds acid phosphate.....	9630	9.75
4	15 loads manure 800 pounds acid phosphate.....	9630	10.65
5	15 loads manure 400 pounds 3–10–4 fertilizer.....	9988	10.84
6	15 loads manure 800 pounds 3–10–4 fertilizer.....	9871	9.96
7	800 pounds 3–10–4 fertilizer.....	8046	8.14
8	15 loads manure 400 pounds 5–8–7 fertilizer.....	9261	9.88
9	15 loads manure 800 pounds 5–8–7 fertilizer.....	9411	10.99
10	15 loads manure.....check	9395	10.06

days and 148 days. There was 7.27 per cent leaf-roll in the stock, but mosaic was not observed. In 1925 the various lots mentioned were planted in alternate rows with the same strain of Green Mountains from the original source. The results obtained are given in Table III.

TABLE III—*Effect of maturity of Green Mountain seed on freedom from virus diseases and productivity*

Nature of seed	Per cent mosaic	Per cent leaf-roll	Per cent yellow dwarf	Yield bushels per acre
A				
Strain H 90 day, dug after 90 days..	7.35	9.31	——	220.90
Strain H 90 day, dug after 100 days..	1.40	2.10	——	352.50
Strain H 90 day, dug after 124 days..	0.30	5.38	——	305.40
Strain H 90 day, dug after 148 days..	4.75	7.13	——	255.70
Strain H original source.....	0.04	11.04	0.10	248.30
B				
Strain H, dug after 90 days.....	——	——	——	262.70
Strain H, dug after 100 days.....	4.06	——	——	262.70
Strain H, dug after 124 days.....	3.98	——	——	230.90
Strain H, dug after 148 days.....	——	8.04	——	307.80

In another experiment Green Mountains, strain H, grown at East Kingston in 1924, were harvested after 90 days, 100 days, 124 days and 148 days. The stock in 1924 was free from mosaic but contained 1.37 per cent leaf-roll. The results are given in Table IIIB.

With Irish Cobblers the data were more conclusive. Irish Cobblers strain E were planted in East Kingston in 1923 and dug after 71 days, 82 days, and 92 days. In 1924 the 71-day stock was harvested after 73 and 122 days respectively. In 1924 strain E was planted at East Kingston and harvested after 73 days, 90 days and 122 days. In 1925 the results obtained are shown in Table IV.

TABLE IV—*Effect of earliness of harvest on per cent of leaf-roll and yield of Irish Cobblers*

Nature of seed	Leaf-roll	Yield—relative numbers
71 day, dug after 73 days	0.00	140
71 day, dug after 82 days	1 18	150
71 day, dug after 90 days	0.00	—
71 day, dug after 122 days	5 14	103
82 day, dug after 73 days	2.52	242
82 day, dug after 122 days	10 70	106
92 day, dug after 73 days	6.60	—
92 day, dug after 122 days	32.69	—
Strain E, dug after 73 days	0.00	132
Strain E, dug after 90 days	2 66	—
Strain E, dug after 122 days	6.15	—
Strain E, from original source	0 08	100

A study was also made of the effect of temperature on mosaic. Potatoes affected with the disease were planted in glazed pots and the water in the soil was kept at 70 per cent of saturation of the air dry soil. The plants were then divided into four series of five pots each, as follows: Series 1, plants exposed to a temperature of 28° C. or above for four hours daily; series 2, plants exposed for two hours daily; series 3, plants exposed for one hour daily; series 4, plants not exposed to a temperature above 25° C.

The plants were all grown in the same greenhouse except during the period of heating. When the temperature was raised, the plants in Series 4 were removed to a cool greenhouse and those in Series 2 and 3 after the required exposure to heat were also removed to the same greenhouse. After the plants in Series 1 had been heated four hours, the greenhouse was rapidly cooled; and when the temperature had fallen to 25° C. the plants in Series 2, 3 and 4 were returned to it.

Mosaic symptoms remained perfectly obvious throughout the experiment in the plants of Series 4; in Series 3 the leaves became normal as regards margin and smoothness of blade but remained faintly mottled; in Series 2 mosaic symptoms were faint though recognizable; in Series 1 mosaic symptoms were not recognizable. At the close of the experiment the crop was harvested and the following yields obtained:

	Tubers per plant Mean weight in grams
Series 1. Plants heated 4 hours	45.10
Series 2. Plants heated 2 hours	41.69
Series 3. Plants heated 1 hour	37.57
Series 4. Plants not subject to heat	36.06

Spraying and Dusting Potatoes—*(Hatch Fund)*

In continuation of previous work a study was made by O. Butler of the relative value of hand dusting and spraying for the control of potato diseases. The sprayer used was the Vermorel Eclair, and the dusters the Vermorel double-action Torpille and the Niagara blower. An 8-4-50 Bordeaux mixture was applied every two weeks with the sprayer. Sanders dust containing 8.6 per cent metallic copper was applied both weekly and fortnightly with the Niagara blower, and weekly only with the Vermorel Torpille.

During August the potatoes in all the plots suffered severely from tip-burn. On Aug. 22 the plants in the non-treated plots were dying, and those in the plot dusted every two weeks were also in very bad condition. The plots dusted weekly and the sprayed plot were, however, still fairly green. On Aug. 29 the potatoes in the non-treated plots were dead; the plants in the plot dusted fortnightly were also dead; the plants in the plots dusted weekly and in the sprayed plot were, on the other hand, still slightly green, but died shortly after Sept. 3.

The plots were harvested in October. The amount of copper applied and the yields obtained were as follows:

	Copper per acre	*Yield per acre*
No treatment		222 6 bu.
Sanders dust weekly, Niagara blower	43.0 lb.	279 8 bu.
Sanders dust fortnightly, Niagara blower	14.6 lb.	225 7 bu.
Sanders dust weekly Vermorel Torpille	39.1 lb.	253 0 bu.
Bordeaux mixture 8-4-50 fortnightly	16.9 lb.	247.5 bu.

It will be apparent from the figures given that the efficiency of the unit copper in Sanders dust is low and does not compare favorably with the unit copper in Bordeaux mixture.

Effect of Differently Cut Potato Seed and Siccatives—*(Hatch Fund)*

Observation having suggested that seed pieces cut from the stem end of potatoes might be more sensitive to adverse conditions than those from the apical halves, the following experiment was undertaken by O. Butler. Certified seed potatoes were cut in half across the

middle, and the apical halves and basal halves placed in separate piles. One lot of seed was then cut from the apical halves and another from the basal halves; and both lots were sacked and allowed to stand eight days. On the eighth day another lot of the same certified seed was divided into apical and basal portions which were then cut into seed pieces as before. All the seed was then planted in four 1-17 acre plots, as shown below:

The plants from Plots 1, 2, and 3 came up well, and a good stand was obtained; but in Plot 4 the plants came up poorly and the stand obtained was very uneven and poor. The yields obtained were as follows:

		Yield per acre bushels
Plot 1.	Seed from bud end cut and planted at once	402.46
Plot 2.	Seed from bud end cut and planted after 8 days	324.49
Plot 3.	Seed from stem end cut and planted at once	394.41
Plot 4.	Seed from stem end cut and planted after 8 days	167.41

The loss in yield resulting from holding seed pieces cut from the apical halves of potatoes eight days was 77.97 bushels per acre, and from holding the seed pieces cut from the stem end halves 227 bushels per acre.

At the same time that the above experiment was made, the effect of using a drier on the vitality of the seed pieces was tested. In this case the seed used was of medium size, was simply cut cross-wise, and was planted at once, and after standing 3 days and 5 days respectively. The seed held after cutting was carefully spread on the floor of a warm room, each seed-piece separate. The results obtained were as follows:

	Not Sulphured per cent	*Sulphured per cent*
Bud end planted at once	83.33	97.22
Stem end planted at once	94.44	94.44
Bud end planted after 3 days	80.55	83.33
Stem end planted after 3 days	63.88	52.77
Bud end planted after 5 days	62.16	72.97
Stem end planted after 5 days	21.87	34.28

It will be noted that again the bud ends of the tubers, while showing the effects of adverse storage conditions, were very much less affected than the stem ends. The use of sulphur as a drier was decidedly beneficial in the case of the seed held 5 days, but no advantage occurred from its use on seed planted at once or after standing 3 days.

Potash Tests on Potatoes—(*Hatch Fund*)

These tests were begun in 1922 by F. W. Taylor and have now continued for five years. The object has been to secure data on potato yields where varying amounts of potash were applied with fixed amounts of nitrogen and phosphoric acid. The seed used was certified Maine grown Green Mountain, carefully cut with two eyes to the piece. The potatoes were planted May 21 and harvested September

28. This year no manure was used; in previous years twenty spreader loads have been applied.

Table V indicates the yields per acre for each of the several treatments during the five years of the test.

TABLE V—*Yields of potatoes per acre on plots treated with varying amounts of potash*

Fertilizer grade	Bushels 1922	Bushels 1923	Bushels 1924	Bushels 1925	Bushels 1926	Average five years
4–8–0	215.1	242.0	206.6	297.6	174.4	227.1
4–8–3	215.7	252.5	244.4	303.0	184.3	239.9
4–8–6	246.6	226.0	248.6	366.6	175.3	252.6
4–8–10	222.2	214.5	256.1	356.8	208.5	251.6
Check	149.0	192.0	164.0	258.7	166.2	185.9

The fertilizer was applied at the rate of 1200 lbs. per acre of a 4-8-0 grade plus enough muriate of potash to make the 3, 6, and 10 per cents. For the first four years the plots were one-quarter acre in size; in 1926 they were cut to 9 x 20 and were run in duplicate. While the results of these tests are not consistent in every respect, they seem to indicate that where stable manure is used in medium applications, the supplementary fertilizer need not contain more than 4 to 6 per cent of potash.

Fertilizer Placement Tests on Potatoes—(*Hatch Fund*)

In order to secure some data on the effects of different distributions of the fertilizer on the yield of potatoes, four different methods of application were used on duplicate plots. The seed pieces were cut uniformly to two eyes per piece and were planted one foot apart in the row. The potatoes were planted May 21 and harvested September 30. The average yields per acre with each method of application are shown in the following table:

Fertilizer above the seed	212 6 bus.
Fertilizer below the seed	214 6 bus.
Fertilizer at side of seed	225 7 bus.
Fertilizer with the seed	229 7 bus.

The mixture of fertilizer used was a 4-8-4 grade and was applied at the rate of 1800 lbs. per acre. No striking results were secured.

The Value of Manure for Potatoes—(*Hatch Fund*)

The question is frequently asked: What is a ton of manure worth, or, how valuable is manure for this crop or for that? In order to get some figures on this question as it affects potatoes, plots were planted in duplicate with "no fertilizer", with 12 tons of manure per acre and with 24 tons per acre. The manure used was partially rotted and was harrowed in just before planting. The yields per acre were as follows:

No fertilizer	166.2 bus.
12 tons of manure	198.4 bus.
24 tons of manure	229.7 bus.

In this case 12 tons of manure increased the yield 31.3 bus. over "no fertilizer", and 24 tons increased it 63.5 bus. This year the selling price of potatoes was $1.65 per bushel, which gave a value of $4.43 for each of the first 12 tons of manure used, and of $4.30 for each of the last 12 tons used, with no allowance being made for residual effect of the manure on succeeding crops. Obviously, however, the value of a ton of manure is dependent largely upon the selling price of the crop produced.

Effect of Nature of Seed Piece—(*Hatch Fund*)

Certified seed growers sell to some extent seconds for seed, and it was thought desirable to study the behavior of "firsts" and "seconds" in respect to the per cent of degeneration diseases in the stock produced. The results secured by O. Butler suggest that small seed planted whole produced stock somewhat freer from mosaic and leaf-roll than did standard-size cut seed, as will be seen from the effect of size of seed on mosaic and leaf-roll figures in Table VI.

Table VI.

	Mosaic	*Leaf-roll*
D stock "firsts"	3.61%	1.11%
D stock "seconds"	2.11%	0.52%
H stock "firsts"	0.00%	10.13%
H stock "seconds"	0.00%	10.13%
R and J stock "firsts"	0.62%	3.40%
R and J stock "seconds"	0.90%	2.42%

Spraying Mustard—(*State Fund*)

Experiments were begun for the purpose of making a comparative study of the various substances that have been used to control mustard. Tests have been made with copper sulphate, ferrous sulphate, sodium nitrate, sodium nitrate and copper sulphate, calcium chloride, arsenite of soda.

FORESTRY

Forest Plots—(*Hatch Fund*)

The usual measurements in the plantations were made and several additional plots established so as to have a complete series of plots in pure white pine from stands ten to forty years old. In a series of plots twenty years old, the experiments which Mr. O. M. Pratt of Holderness has been carrying on for the last twenty years with reference to pruning will be checked. Mr. Pratt's work has been so unique that foresters from many other states have come to see what he has accomplished.

HORTICULTURE

Fruit Bud Formation—(*Adams Fund*)

Work on the fruit bud formation project has been divided into three main lines: 1, the usual records of yield and growth in the Woodman Orchard; 2, a more detailed study of the effect of the fertilizers on the method of bearing in three of the plots of the Woodman Orchard which show the widest differences; 3, the study of the relation of chemical composition to performance in fruit bud formation.

In the Woodman Orchard the usual records covering total yield in pounds per tree, the average annual twig growth as determined by 20 random measurements and the increase in trunk diameter were taken by G. F. Potter and S. W. Wentworth. In addition, counts were made this season on the size of apples as determined by weighing two or three boxes from each tree and counting the number of fruits in each. The results, excepting for the data on trunk diameter, are given in Table VII.

The yield for one season is, of course, of relatively little significance owing to the tendency to alternate in yield. However, it may be noted that the heaviest crop this year was in Plot 9 which is highly fertilized with nitrogen, which has the highest average yield for the

TABLE VII—*Effect of fertilizers on yield, size of fruit, and twig growth in the Woodman Orchard for* 1926

Plot	Treatment	Average yield per tree 1926 (*pounds*)	Average size of fruits 1926 (*ounces*)	Average twig growth 1925 (*inches*)
1	Sod	83.9	——	2.66
2	Cultivated alternate years. Cover crop	7.3	——	2.11
3	Cultivated alternate years. Cover crop	323.0	3.52	3.12
4	Clean cultivation. No cover crop	51.8	4.29	3.06
5	Clean cultivation plus cover crop	138.2	4.26	2.84
6	Cultivation and cover crop plus complete fertilizer (phosphorus as basic slag)	234.0	4.11	2.72
7	Cultivation and cover crop plus complete fertilizer	150.3	3.95	2.15
8	Cultivation and cover crop plus complete fertilizer with extra phosphorus	150.0	3.97	2.40
9	Cultivation and cover crop plus complete fertilizer with extra nitrogen	374.3	3.94	2.50
10	Cultivation and cover crop plus complete fertilizer with extra potash	89.9	3.95	2.49

last eight years, and which is also characterized by more regularity in bearing than the other plots.

It was expected that the data on size of fruit taken for the first time this season would indicate a greater difference in favor of the highly fertilized plots. However, during this summer there was relatively little rainfall, and the size was more largely limited by lack of water than is usually the case. It is believed that under ordinary circumstances data of this character would indicate a material increase in size of the apples in the fertilized plots. The average twig growth for the season of 1925 was relatively small, and was not at all typical of the relations usually found in these plots.

In order to gain a more clear insight into the changes in manner of growth and method of fruiting, detailed records have been made on branches selected at random in Plots 1, 6, and 9. The labor of conducting this work is such that it is impossible to apply this method to all of the plots. Plot 1 represents the trees in sod which receive no fertilizer, make a weak growth and have declined materially in yield during the past eight to ten years. This plot has always been the lowest yielding one in the orchard.

In Plot 9 cultivation and cover crop together with the application of six pounds nitrate of soda and other chemical fertilizers have made the trees the most vigorous in the orchard. Instead of declining in yield they show an increase on the average for 1919-1925 of nearly 75 per cent over their production for the preceding ten years, 1909-1918 inclusive. These trees are resisting winter injury and the inroads of canker more successfully than the others in the orchard.

In Plot 6 the trees are in an intermediate condition, making a medium growth and approximately holding their own so far as yield and vigor are concerned.

The data obtained will be published shortly in bulletin form, but it may be said now that from general observations and from annual measurements of the crop covering the years 1919-1925, it appears that Plot 9 is definitely more regular in bearing than Plot 6. The evidence indicates that this cannot be attributed to any large extent to successive bearing by the same branches. It appears to be due to the greater annual production of new spurs and their greater tendency to fruit in their second season. The evidence indicates, however, that in large measure the crop is on different small branches in successive years.

Relation of Composition to Performance of Fruit Spurs

A new phase of this experiment was begun in 1925 by G. F. Potter and T. G. Phillips in twenty-six different plots, each of from six to nine Baldwin apple trees growing under a variety of environmental conditions. Spurs were sampled at two periods—those most advantageous as determined by previous work—about July 1 and a month later. Care was taken to have all the branches of each tree represented in the composite sample. Only non-bearing spurs were used, and these were cut at the base of the new growth made during the season in which the samples were taken. In most instances the sample consisted of about 250 spurs or from 40 to 60 from each tree;

it is felt, therefore, that they should fairly represent all the non-bearing spurs on these trees at the sampling date.

In May, 1926, counts were made as to the number of blossoms produced by spurs non-fruiting the previous season and similar in every respect to those used for analysis during the previous year. Counts of at least 30 spurs were made in ten different parts of the tree. Where the stubs of spurs sampled the previous season could be seen, care was taken to make counts on the spurs immediately adjacent to those which had been used for the chemical samples. In all, counts were made with about 96,000 spurs. These indicate that the different plots have an excellent range in percentage of fruit buds produced, varying from 2.7 per cent in Plot 2 of the Woodman Orchard, to 59.2 per cent in Plot 10 of the Renovated Orchard at the Horticultural Farm, with the remaining 24 plots distributed between these two in a fairly uniform sequence.

Chemical analysis has been carried on as outlined. By having a large number of plots and studying the results by means of correlation coefficients, it is expected that it will be possible to sift the evidence and determine which constituents of the spur are uniformly associated with high percentage of flower bud formation. The mathematical work is just now being begun.

Late Fertilizer Applications and Fruit Bud Formation

A new phase of the fruit bud work was inaugurated this season, namely a study of the effect of late applications of nitrogenous fertilizers on trees growing in sod. The usual practice in orchards of this sort is to apply about five pounds of nitrate of soda or some similar material to each large bearing tree before the blossoms open. Trees under this treatment were compared to trees receiving in addition approximately fifty per cent of this amount between July 1 and about August 1. This work has been carried on in an old Baldwin sod orchard at the Horticultural Farm and also in an excellent commercial orchard of the same variety about 40 years of age, the property of A. P. Rockwood in Temple, N. H. A few trees of McIntosh are also under test in Temple.

In the Baldwin orchard at the Horticultural Farm these fertilizer applications were made during the seasons of 1925 and 1926. In the spring of 1926 counts were made of the percentage of fruit buds formed under each treatment. These results are presented in Table VIII. It will be noted that the fertilizer did not affect percentage of fruit buds formed.

Records were taken this season to measure the effect of the fertilizer, if any, on the size of the apples by counting and weighing the fruits. The results obtained are presented in Table IX.

It appears that the fertilizer has had no effect on size. Some question may be raised, however, because the average yield is nearly one-third greater on the trees receiving late fertilization; in fact several trees in the plot fertilized in the spring only bore very few and consequently relatively large fruits. Using the method published by Wallace and Snedecor, it may be found that the correlation coefficient between yield in pound and size of fruit in ounces is -0.647 ± 0.088. From this

TABLE VIII—*Influence of late fertilization with nitrogen on fruit bud formation*

PLOT A FERTILIZED MAY, 1925		PLOT B FERTILIZED MAY AND AUGUST, 1925	
Tree number	Spur blossoming 1926 (*per cent*)	Tree number	Spur blossoming 1926 (*per cent*)
12	64.0	11	10.4
18	46.9	19	13.6
25	12.1	26	3.6
45	——	36	17.9
35	3.9	46	23.6
38	12.0	42	18.4
24	10.6	17	36.4
23	9.5	16	40.7
10	7.5	15	22.5
Average	18.5±4.9	—	20.8±2.6

figure a regression coefficient may be calculated and a corrected value obtained for the expected size of fruit considering the crop. This figure represents an average for the whole group as modified by the weight of crop for each individual tree.

Comparing the actual size of fruits with that expected, it may be noted that the fruits on the trees fertilized in spring only are 0.03 ounce smaller than expected, while those fertilized both in spring and in the late summer average 0.06 ounce larger. This difference is too small to be significant when considered in relation to the probable error. Within the accuracy with which this measurement was made, therefore, the late fertilizer has not appreciably increased the size of the apples.

No counts were made of the relative per cent of blooms setting fruit in each of the two plots; but because the fruit bud formation was approximately the same and the size of the fruits was not materially different, the increased crop on the trees receiving late fertilizer must have been due to a better set.

The original data for about 25 Baldwin and 8 McIntosh trees in Temple, N. H., have been taken but have not as yet been summarized.

Winter Injury of Apples—*(Adams Fund)*

Owing to increased activity in other fruit investigations, the winter injury project has been inactive during the present fiscal year. The material for histological study of injury in the tissues of apple seedlings, following subjection to various degrees of cold, is on hand, and the work will be resumed later.

TABLE IX—*Influence of late fertilization with nitrogen on size of Baldwin apples*

PLOT A FERTILIZED MAY, 1925 AND 1926				PLOT B FERTILIZED MAY AND AUGUST, 1925 AND 1926			
Tree number	Total yield (*pounds*)	Average size of fruits: Actual (*ounces*)	Average size of fruits: Calculated on basis of yield (*ounces*)	Tree number	Total yield (*pounds*)	Average size of fruits: Actual (*ounces*)	Average size of fruits: Calculated on basis of yield (*ounces*)
10	100	4.54	4.71	11	153	4.03	4.58
12	468	3.82	3.79	15	258	4.36	4.32
18	357	3.79	4.07	16	340	4.48	4.11
23	112	4.71	4.68	17	494	4.13	3.73
24	24	5.72	4.90	19	96	4.96	4.72
25	44	5.68	4.85	26	3	4.80	4.95
22	168	4.58	4.54	34	138	4.86	4.62
29	167	3.55	4.54	42	102	4.27	4.71
38	40	4.85	4.86	46	172	4.73	4.53
43	145	4.07	4.60	—	—	——	——
45	2	4.80	4.96	—	—	——	——
Average	148	4.56±0.15	4.59	Average	195	4.51±0.07	4.45

TABLE X—*Wood removed and growth under different methods of pruning*

	Vase	Semi-leader	Full leader	Unpruned
Pounds of wood removed in pruning, spring of 1925	1.40	1.45	1.09	——
Weight of prunings relative to size of tree, 1925	1.40	1.38	1.02	——
Diameter in inches at close of 1925	3.08	3.36	3.32	1.98
Inches increase in trunk diameter, 1925	0.51	0.67	0.58	0.28
Pounds of wood removed in pruning, spring of 1926	2.67	3.42	3.76	——
Weight of prunings relative to size of tree 1926	2.67	3.14	3.48	——
Yield per tree in pounds, 1926	4.12	4.89	6.09	——

Pruning Experiment with Apples—(*Hatch Fund*)

Data are presented in Table X on the pruning and the growth of Spy and McIntosh trees at the close of their seventh season under different systems of pruning. Data are also included on the amount of pruning done in the spring of the eighth season.

Unfortunately in this experiment all the trees under a given treatment are planted in the same block; hence differences in growth cannot be ascribed wholly to the differences in pruning treatment. The unpruned trees are smallest in this instance, due in all probability wholly to unfavorable soil in the portion of the orchard in which they are planted. In similar experiments elsewhere the unpruned trees have usually made greater total growth than those pruned. During the season of 1925 the gains in trunk diameter were in proportion to the previous growth of the trees, those plots which were largest at the outset making greatest gains during the season. In all instances, considering the conditions, the differences in growth are too small to be ascribed to the pruning.

Fertility in the Peach Orchard—(*Hatch Fund*)

The crop of peaches harvested in 1926 was only fair. Data on yield and growth as affected by different fertilizer treatments are given in Table XI.

It is evident that factors other than the different fertilizer treatments are responsible for differences between the plots. For instance, there would appear to be no logical reason why a tree fertilized with nitrate of soda and acid phosphate should yield less and make a smaller growth than a tree fertilized with nitrate of soda alone. An effort has, therefore, been made to arrive at averages which will have greater significance than the results in any one plot.

It is apparent that the use of nitrogen has resulted in an increased growth and yield, although in this case it is necessary to compare the plots receiving nitrogen with a single plot, No. 3, the only one which does not receive this fertilizer. It may be said, however, that the division rows which separate the plots and which do not receive nitrogen, are in all cases visibly smaller than the trees on either side which do receive it. This is true in spite of the fact that the trees in the division rows must gain some benefit from the fertilizer applied to the rows on either side.

In 1925 those trees which received nitrogen with potash had a greater yield than those receiving nitrogen without potash. It was stated, however, at that time that the difference was scarcely sufficient to be considered significant. It may be noted in the data for 1926 that the potash-treated trees show no greater growth or yield.

Because Plots 1 and 2, which receive no phosphorus, are believed to be better situated than Plots 4 and 5, it is not possible to draw any conclusion as to the effect of this element.

The only satisfactory evidence, therefore, is as to the value of nitrogen in the peach plantation.

TABLE XI—*Effect of fertilizers on yield and growth of peach trees*

Plot	Treatment per tree	Average yield per tree (*pounds*)	Average twig growth (*inches*)	Average trunk diameter (*inches*)
1	2 pounds nitrate of soda	33.6	10.4	5.5
2	2 pounds nitrate of soda 1 pound muriate of potash....	26.8	7.6	5.5
3	Check	6.3	6.6	4.7
4	2 pounds nitrate of soda 3 pounds acid phosphate	8.2	8.0	4.7
5	2 pounds nitrate of soda 1 pound muriate of potash 3 pounds acid phosphate	9.6	8.5	5.0
Average 1–2–4–5	Nitrogen alone or in combination	19.6	8.6	5.2
Average 1–4	Nitrogen without potash	20.9	9.2	5.1
Average 2–5	Nitrogen with potash.....	18.2	8.5	5.2

Variety Test of Fruits—(*Hatch Fund*)

No new varieties of apples worthy of note fruited in the Station test orchards this year. Observations have been made, however, both at the Station and in other sections by G. F. Potter with reference to varieties of apples, pears, and plums. During the year there was obtained by means of a commercial survey a rating of the relative value of the more important sorts grown in the state as determined by the opinion of the commercial apple growers. This shows the Baldwin and McIntosh to be the two outstanding apple varieties, constituting more than 70 per cent of the total trees in commercial orchards in the state. In few fruit sections in America is the planting so generally restricted to a small number of desirable commercial varieties. The results of the survey indicate that although there are a total of two and one-half times as many Baldwin trees as there are McIntosh, in recent years practically as many McIntosh have been planted as Baldwin. The returns also indicate that whereas ten to fifteen years ago the McIntosh was widely planted as a "filler", the recent plantings are more largely composed of permanent trees. The increase in production of McIntosh for the next fifteen years is estimated at approximately 43,000 barrels, whereas the increase in Baldwin will be approximately 80,000 barrels. The 1940 crop of McIntosh, however, will be more than 300 per cent of the present crop while that of Baldwin will be only 50 per cent larger than those harvested at the present time. The McIntosh variety blossomed heavily in New Hampshire and throughout New England in the spring of 1926 but set a very light

crop because of unfavorable weather conditions. It appears to be more subject to troubles due to lack of proper pollination than most other sorts, and in view of its increasing commercial importance a special study of its pollination problem should be undertaken.

The increasing popularity of the McIntosh has led to efforts on the part of Experiment Stations interested in plant breeding to produce varieties similar to it which will extend its season. Three of these sorts have been planted in the Station test orchards this year, namely, the early McIntosh, the Macoun, and the Melba.

Trees of the Cortland, a McIntosh seedling which is later in season than the parent, were planted in 1922 and have made excellent growth. No fruit has as yet been obtained. In addition to the varieties mentioned Red Gravenstein and Red Spy were added to the list of varieties under test. These bud sports of old standard varieties are of interest because of the higher commercial value of well colored fruit.

Pears

The pear trees in the college orchards bore a fair crop in 1926. Observations were made by L. P. Latimer on trees in two orchards, one in sod in relatively thin dry soil, and the other of cultivated trees eight years of age in a relatively heavy soil. A number of varieties show considerable promise as observed here and also in other parts of New Hampshire. The trees of Flemish Beauty have made good growth and are healthy. The form of the tree is somewhat spreading and open. The crop was heavier than that of any of the other varieties in sod. The pears were of good size and free from scab, the only defect being that they had a tendency to drop rather badly in the sod orchard. The fruit is of high quality and the tree is as hardy to cold as any other variety. In the cultivated plot trees of this variety had by far the heaviest yields. The trees were vigorous and the fruit of good size. The variety may be promising for the home garden.

The trees of Clapp Favorite are in general healthy and are among the most vigorous on the Station grounds. A good crop of large fruit was produced on all trees under cultivation and in sod. The variety is hardy to cold and is known in other sections as a regular bearer of high quality fruit.

The trees of Clarigeau are upright in form and especially vigorous. The crop this season was good, comparing favorably with Clapp Favorite. The fruit was of good size and color and, although heavy, hung well to the tree until mature enough to harvest. It sized up remarkably well in spite of the fact that there was a heavy set and the trees had not been thinned. Although of mediocre quality the fruit is handsome and attractive because of its good form and intense red color.

Trees of Bartlett appeared less vigorous on sod and produced a lighter crop than Clapp Favorite, Flemish Beauty and Clarigeau under similar conditions. The young trees under cultivation made a somewhat better showing as compared to the other varieties. There was little difference in date of maturity between Bartlett and Clapp Favorite, but the former proved to be a better and longer keeping variety after picking.

During the past year the Anjou (Beurre d'Anjou) has not at this Station lived up to its reputation in other fruit growing sections of the United States. The trees in sod were lacking in vigor. Under cultivation the trees had done fairly well but were not as large as those of the other varieties previously described, and no fruit was produced. The fruit on the trees in sod dropped badly. Whether or not this was due to a lack of proper pollination has not been determined.

In the cultivated plots Lawrence, Sheldon, Seckle and Angouleme have made a fair growth but produced no crop. Keifer has grown rapidly and has produced more or less fruit for the past two or three seasons. However, it matures so late that the fruit is of poor size when harvested the last of October. In addition to Anjou previously mentioned, the Tyson and Bosc have made relatively slow growth. The Bosc pear is notoriously a poor grower, and it is the practice in commercial plantations to plant other varieties and then top work to Bosc.

Plums

In addition to the Japanese sorts most commonly grown in New Hampshire, a crop of plums was obtained in 1926 on some European varieties. Observations on the relative quality and adaptability to New Hampshire conditions were made by L. P. Latimer. Lombard bore a heavy crop of good size, clean, highly polished fruit. The tree in spite of the heavy crop was in fine condition. It was more robust and healthy than any other variety in the test orchard. Its form is very satisfactory, being upright and symmetrical. The leaves were large, glossy green, and healthy. The quality was fairly good—good for cooking or canning. The crop matured in mid to late season.

The fruit of the Washington was green to yellowish and of good quality. It tends to become soft and mushy when ripe but is good for cooking. The crop was light and the trees less vigorous than other varieties. It matured in mid to late season.

Imperial Gage is similar in tree characters to Washington, but the fruit was better in quality. The yield was not heavy and the size of the fruits about medium.

Bradshaw produced a good crop of large dark purple or dark blue plums. It matured its fruit earlier than any of the other European sorts described. Its quality, however, is not such as to recommend it for extensive planting.

The Shropshire Damson is very prolific and healthy and produced handsome fruit, astringent at first but more palatable when thoroughly ripe. It is excellent for culinary purposes. In season it is slightly earlier than Lombard.

The Climax, a variety of Japanese plum, produced fruit rather low in quality and has little to commend it for planting.

Effect of Fertilizer on Strawberries—(*Hatch Fund*)

In the spring of 1925 Howard 17 strawberry plants were set on a field of sandy loam at the Horticultural Farm which previously had been used as a nursery and had received approximately ten tons of stable manure per acre annually for several years. The land was di-

vided into nine plots, each approximately 1-20 acre. Immediately after the plants were set, nitrate of soda was applied to two plots at the rate of 200 pounds per acre; to two at the rate of 300 pounds per acre; and to two at the rate of 400 pounds per acre. On three plots no fertilizer was applied.

The berries were harvested between June 25 and July 11, 1926. Yields of each plot were kept separate, but the variation between plots was such that no conclusions can be drawn as to the effect of nitrate at the different rates of application. However, the average yield from the six plots receiving nitrate is distinctly less than that from those plots which did not receive the application. The yields are shown in Table XII.

TABLE XII—*Yield of 1/20 acre strawberry plots*

Treatment	Average yield per plot		
	June 25 to July 3 (*quarts*)	July 4 to July 11 (*quarts*	Total for the season (*quarts*)
Nitrate, 200 to 400 pounds per acre	48.41±3.52	21.98±5.66	70.39±7.23
Check, no fertilizer.	61.93±6.99	40.90±6.09	102.83±4.48

The average decrease in yield on the fertilized plots is about 32 per cent, but the decrease for the first half of the season is approximately 22 per cent and for the last half about 46 per cent. Apparently the application of nitrate shortens the season.

The season of 1926, in which these results were obtained, was very dry, there being little rain during the first half of the season and none at all during the last half. It is possible that under more favorable conditions of moisture a different result might have been obtained.

In the spring of 1926 plants of Howard 17 strawberries were set in the permanent garden soil fertility plots in a field of sandy loam which originally contained only a small amount of organic matter. For the past eight years these plots have received treatments as listed in Table XIII. The experiment, therefore, gives an opportunity to measure the cumulative effect of fertilizer applications on the strawberry plants. Previous experiments with this fruit at this station have dealt with the effect of application of fertilizer either in the year the plants were set or the year in which they fruited, on soil previously under uniform treatment. The fertilizers in this experiment are broadcast and worked into the soil before the crop is sown or planted. The data are given in the table.

There were 25 rows in the limed half and 25 in the unlimed half of each plot. By recording separately the data for each row it is possible to compute a probable error for the result from the variation recorded in the different rows under similar treatment.

In the main, the differences between limed and unlimed halves of plots are not significant when the probable errors are considered, but in two instances there are large differences in mortality of mother plants. In Plot 4 the per cent of mother plants surviving is considerably higher on the limed half than on the unlimed, even taking the probable error into consideration. However, on Plot 6 with a treat-

TABLE XIII—*Effect of fertilizers on the stand in a matted row strawberry plantation*

Plot	Treatment	Mother plants surviving July 9		New plants per living mother plant	
		Increase of limed over unlimed (*per cent*)	Average entire plot (*per cent*)	Increase of limed over unlimed (*number*)	Average entire plot (*number*)
1	32 tons manure	−6.2±2.0	84.1±1.0	−2.8±1.2	12.6±0.6
2	24 tons manure, 150 pounds tankage, 100 pounds nitrate of soda, 600 pounds acid phosphate, 150 pounds muriate of potash	−9.3±2.8	74.8±1.5	−2.3±0.8	11.6±0.5
3	Green manure, 250 pounds tankage, 160 pounds nitrate of soda, 800 pounds acid phosphate, 300 pounds muriate of potash	+1.4±2.5	73.8±1.2	+1.2±0.8	9.6±0.4
4	16 tons manure, 250 pounds tankage, 160 pounds nitrate of soda, 800 pounds acid phosphate, 300 pounds muriate of potash	+21.0±3.8	46.1±2.1	+2.7±0.9	6.8±0.5
5	Check	+2.4±2.2	81.5±1.1	+1.0±0.6	5.9±0.3
6	8 tons manure, 250 pounds tankage, 160 pounds nitrate of soda, 800 pounds acid phosphate, 300 pounds muriate of potash	−10.0±3.7	35.2±2.0	−1.9±0.6	5.6±0.4
7	Green manure	−12.8±1.6	81.6±1.0	+2.7±0.6	3.6±0.3
Average		−1.9±4.4		+0.6±2.9	

ment not greatly different from that used on Plot 4 the opposite result is obtained. It is believed that these variations, although relatively large, are merely due to coincidence and that the lime is without effect. The same statements apply to the effect of lime on the number of new plants produced from each living mother plant.

One of the notable effects of the chemical fertilizer was a very striking increase in Plots 4 and 6 in the mortality of the plants set out. This was particularly striking to one observing the margins of these plots which were clearly defined by the raggedness of the stand as compared to the plots on either side.

The stand in each of the three plots receiving no chemicals is very uniformly a little above 80 per cent. In Plots 2 and 3 there appears to be some reduction in number of plants surviving, but the reduction is not as great as might be expected considering the results on Plots 4 and 6. This may be due to the smaller quantity of chemicals in the case of Plot 2, but is more difficult to explain in the case of Plot 3, which receives no stable manure but has had green manure turned under whenever there has been an opportunity in the past eight years. It is believed, however, that the amount of organic matter in the soil in Plot 3 is much less than that now present in the soil of any of the other plots except 5 and 7. No adequate explanation can be given for the results obtained in Plot 3.

In the number of new runner plants arising from each mother plant the results show a marked benefit from the application of the stable manure. In fact, the differences between the check and the plots receiving stable manure in number of new plants formed, are in each

instance almost exactly proportional to the amount of stable manure applied. Ordinarily, however, one would expect a proportionately greater result from a light application of stable manure than from additional increments. In this case three plots, namely 2, 4, and 6, which receive chemicals in addition to manure, produced slightly fewer runner plants than the number which would be proportional to the manure applied. It is evident that these chemicals do not improve the growth of the plants, and there is some indication that the number of new plants is slightly less than would have been obtained had no chemicals been used.

The results with green manure are conflicting. The number of new plants formed was relatively low on Plot 7. This may be due to soil conditions resulting from the incorporation of green manure, but there is scarcely evidence enough to make this conclusion positive. In Plot 3 conditions evidently were more favorable for production of new plants than in any of the other plots except the two receiving the largest amount of stable manure. If the results from Plot 3 could be accepted, they would indicate a benefit from the use of commercial fertilizers in connection with green manure. However, it is not possible to corroborate this evidence from the results in other plots, as is the case with stable manure and chemicals. Since the conclusions are dependent in each case on a single plot, one cannot be positive that the results are not due to some inherent difference in the fertility or moisture supply.

A study of the runner system originating from each mother plant was made in October. This indicates that in all plots the number of plants taking root from each runner is very uniform, provided the runners are not branched. The plots which had more stable manure produced a greater number of runners and a larger proportion were branched. Branched runners produce more and larger plants than straight runners.

The results on the whole indicate that commercial fertilizers, particularly when used to supplement applications of stable manure, are of no value and in fact are probably somewhat harmful. This raises an interesting question as to why and how the strawberry plants are harmed.

Tomato Variety Tests—(*Hatch Fund*)

The tomato variety tests again show that the early and second-early are the only dependable varieties for New Hampshire conditions. Among the new sorts tried, Canadien, an early variety originated at the Guelph Experiment Station, shows promise. It is a large tomato with considerably more foliage than Earliana. Stark is a large, medium early tomato which also shows excellent promise on its first trial. The results in yield and size of fruit based on a test of about six plants of each variety are shown in Table XIV.

Investigation of tomato varieties was begun in 1925 to determine whether the relative maturity of standard early, medium early, and late varieties was due to earlier growth and earlier production of blossom clusters or to the hastening of the ripening period in the early kinds. Three strains of Earliana, two of Canadien, and one each of

TABLE XIV—*Yield and size of fruit of tomato varieties*

Variety	Yield per plant		Average weight of each ripe fruit (*ounces*)
	Ripe fruit (*pounds*)	Green fruit (*pounds*)	
Red River	4 2	1 7	3 7
Earliana, Langdon	9 7	5 1	4 4
Earliana, Penn. State	10 7	1 2	3 8
Earliana, Burpee	8 8	0 9	3 6
Avon	5 5	9 8	2 1
Canadien, Harris	12 6	4 2	5 2
Canadien, Guelph	8 5	3 7	4 0
June Pink	7 5	—	3 5
Bonny Best, Langdon	2 1	4 2	4 3
Bonny Best, Stokes	2 1	6 6	4 4
Bonny Best, University	4 4	9 2	2 7
Red Head, Langdon	7 4	3 4	4 2
John Baer, Langdon	6 3	10 3	4 1
John Baer	2 7	13 7	4 8
Acme	2 5	10 2	3 4
Chalk's Jewel	3 4	8 2	3 3
Hudson Valley Maid	5 1	7 0	4 6
Stark	6 2	9 3	5 4
Ponderosa	5 2	5 1	6 7
Matchless	1 1	7 6	5 1
New Globe	1 8	6 7	4 8
Marglobe	1 9	7 7	5 0
Stone	1 3	4 9	4 5
Coreless	0 3	6 7	5 0
Dwarf Champion	2 5	3 9	3 2
Dwarf Stone	0 6	3 3	6 2

TABLE XV— *Relation of yield to growth and cluster production in early and late tomato varieties*

Type	Total growth on six plants July 8 (*inches*)	Total clusters on six plants July 22 (*number*)	Ripe fruit on six plants Sept. 10 (*ounces*)	Total growth on six plants July 15 (*inches*)	Total clusters on six plants July 30 (*number*)	Ripe fruit on six plants Sept. 18 (*ounces*)	Total growth on six plants July 30 (*inches*)	Total clusters on six plants August 12 (*number*)	Ripe fruit on six plants Sept. 22 (*ounces*)
Early	204	47	298	390	84	542	1278	244	811
Medium	138	24	87	288	48	202	1074	203	413
Late	78	7	24	144	16	48	708	94	120
Dwarf	60	11	10	114	27	67	426	78	149

TABLE XVI—*Growth and yield per plant in early and late tomatoes on the basis of each cluster of flowers produced*

Type	FOR ONE FLOWER CLUSTER PRODUCED ON OR BEFORE JULY 22		FOR ONE FLOWER CLUSTER PRODUCED ON OR BEFORE JULY 30		FOR ONE FLOWER CLUSTER PRODUCED ON OR BEFORE AUGUST 12	
	Total growth per plant July 8 (*inches*)	Yield per plant Sept. 10 (*ounces*)	Total growth per plant July 15 (*inches*)	Yield per plant July 30 (*ounces*)	Total growth per plant July 30 (*inches*)	Yield per plant Sept. 22 (*ounces*)
Early	4.3	6.4	4.6	6.5	5.2	3.3
Medium	5.8	3.6	6.0	4.2	5.3	2.0
Late	11.1	3.4	9.0	3.0	7.5	1.3
Dwarf	5.5	0.9	4.2	2.5	5.4	1.9

Red River, Avon, and June Pink were used to represent the early kinds; three strains of Bonny Best, two of John Baer, and one each of Chalk's Jewell, Red Head, Acme, Ponderosa, Stark and Hudson Valley Maid for the medium-early; Matchless, Coreless, Globe, Marglobe and three strains of Stone for the late; Dwarf Champion and Dwarf Stone for the dwarf.

The relation of growth to blossom cluster and fruit production shown in Table XV indicates that the early types grow more rapidly early in the season while the late types grow too late to produce fruit that will ripen. Growth and blossom cluster production are closely correlated in plants of the same type. With the earlier varieties it takes new growth two weeks to produce blossom clusters and the first fruits on these clusters five to six weeks to mature. The relations are somewhat different in the other types.

In Table XVI it may be noted that the early types require less time for ripening; the amount of fruit per blossom cluster on July 8 ripened by Sept. 10 is 6.4 ounces for the early, 3.6 ounces for the medium, and 3.4 ounces for the late kinds.

It is possible that a part of this difference may be due to a difference in size of blossom clusters. If, for instance, 10 fruits set on each cluster of early tomatoes and 5 on each cluster of the late, and if ripening proceeded at the same rate in each case, there would be more ripe fruit after a given period on the clusters of early fruit. This possibility will be investigated further next season.

Effect of Phosphorus on Cabbage—(*Hatch Fund*)

In 1926 the phosphorus plots formerly planted to tomatoes (See Technical Bulletin 28) were planted to cabbage. Each plot is 20 x 34 feet in size with a division row between plots. The cabbage was planted in check rows two feet apart in the row and three feet between rows. There are eight fertilizer treatments, each of which is repeated four times, although the cabbage plants on three plots were injured by wood-chucks to such an extent that one series of plots had to be discarded.

The results presented in Table XVII are not as striking as in the case of tomatoes. However, the phosphorus did produce an earlier growth in the cabbage plants, and the phosphorus plots show an increase over the check of from 6 to 10 per cent. While this is not a large increase, the results which represent 12 different plots are very uniform and are believed to be significant. The extra manure plot, however, gives a much higher yield than the phosphorus plots. The reverse was true with tomatoes.

Cabbage Fertilizer Experiment—(*Hatch Fund*)

The cabbage fertilizer experiment at the Horticultural Farm included 192 plots each 22½ x 16 feet in size. One half of these plots were on land which had been planted to cabbage the preceding year, and the remainder were on land which had been in sod for a number of years previous. One half of the new land and one half of the old land were fertilized with stable manure at the rate of 20 tons per acre. Eleven different fertilizer treatments were used, ten of which were repeated 16

times and the eleventh, which was a treatment of ten tons of stable manure per acre, was repeated 32 times. There were, therefore, four plots under a given treatment on the land which had been cultivated two years but not manured; four similar plots on the land newly broken in 1926 and fertilized with stable manure; and four on the land newly broken in 1926 but not fertilized with stable manure. Five of the treatments used contained nitrogen in an amount equivalent to

TABLE XVII—*Effect of phosphorus and other fertilizers on yield and size of head in Danish Ballhead cabbage*

Plot	Treatment	Average yield per plot tons per acre	Average yield per plot pounds per acre	Variation from check pounds per acre	Yield expressed as per cent of check	Average size per head pounds
1	40 tons manure per acre	19.1	38290	8038	126.6	5.3
2	20 tons manure, check	15.1	30252	check	100.0	4.2
3	20 tons manure, 1000 pounds gypsum	14.4	28832	−1420	95.3	4.0
4	20 tons manure, 1000 pounds acid phosphate	16.0	32009	1757	105.8	4.4
5	20 tons manure, 500 pounds acid phosphate	16.1	32153	1901	106.3	4.5
6	20 tons manure, 1000 pounds acid phosphate, 1000 pounds muriate of potash	15.3	30613	361	101.2	4.2
7	20 tons manure, 1000 pounds muriate of potash	14.6	29144	−1108	96.3	4.0
8	20 tons manure, 1500 pounds acid phosphate	16.6	33212	2960	109.8	4.9

that applied in ten tons of stable manure; the treatment known as the check. In addition, there were two acid phosphate and one muriate of potash series. The results are given in Table XVIII.

The land that was cultivated two years yielded 27,774 pounds per acre; the land cultivated one year, 22,214 per acre, or an increase for the former area of 25.4 per cent. On the old land the yield on the manured part was at the rate of 25,685 pounds per acre and on the unmanured part 19,853 or an increase of 79.7 per cent due to manure. On the new land the yield on the manured portion was 25,862 and on the unmanured portion 18,564, an increase of 39.3 per cent. A narrow ridge of lighter soil which yielded higher than the rest of the field ran through the unmanured half and partially accounts for the higher yield, as well as for the very high yields of the plots receiving 2000 lbs. of acid phosphate and the mixed fertilizer plots in the new unmanured land. The very low yield of the Leuna Salt Peter plot is due to the wet location of two plots of the series.

Where 20 tons of manure per acre had been applied, acid phosphate increased the yields approximately as much as an additional 10 tons of manure, but in the absence of manure, especially in the new land, the yields of cabbage were higher on the acid phosphate plots than in the extra manure plots.

In the presence of some manure the quickly available chemical sources of nitrogen yielded as high or better than the same amount of

TABLE XVIII—*Effect of fertilizers on yield and size of Danish Ballhead cabbage*

Fertilizer		On land previously in sod						On land cultivated two years					
		Plots receiving 20 tons of manure per acre			Plots to which no manure was applied			Plots receiving 20 tons of manure per acre			Plots to which no manure was applied		
Kind	Amount applied per acre (*pounds*)	Average weight head (*pounds*)	Yield per acre (*pounds*)	Yield as per cent of check	Average weight per head (*pounds*)	Yield per acre (*pounds*)	Yield as per cent of check	Average weight head (*pounds*)	Yield per acre (*pounds*)	Yield as per cent of check	Average weight head (*pounds*)	Yield per acre (*pounds*)	Yield as per cent of check
Leuna Salt Peter.	385	5.0	30693	123.3	2.2	6816	38.3	5.4	37289	109.8	3.2	15689	70.6
Calcium Nitrate.	650	4.8	27830	111.8	3.1	15790	88.8	5.3	32130	96.4	3.7	18755	84.4
Sodium Nitrate.	680	4.6	24381	98.0	3.6	17746	99.7	6.4	39385	115.9	3.1	17938	80.7
Acid Phosphate.	1000	3.4	20630	82.9	3.6	21054	118.3	5.4	34908	102.8	3.5	20963	94.3
Tankage.	1053	4.1	24865	99.9	2.8	11616	65.3	5.4	35150	103.6	3.2	17424	78.4
Ammonium Sulphate .	450	4.5	25348	101.9	3.0	12886	72.4	5.4	37106	109.3	3.1	15064	67.8
Muriate of Potash. . . .	1000	4.1	21417	86.1	2.4	10224	57.5	5.2	34031	100.2	4.4	16819	75.7
Urea.	225	4.8	27063	108.7	4.8	28556	160.6	5.3	36905	108.7	3.3	17666	79.5
Acid Phosphate.	2000	4.5	25853	103.8	4.2	29947	168.4	4.9	35416	104.3	4.8	27406	121.8
5-8-7 mixed Fertilizer.	2000	4.8	31520	126.6	4.9	31782	178.1	5.1	35654	105.0	4.2	28430	127.9
Extra manure, check. .	10 tons	4.2	24885	100.0	3.3	17787	100.0	5.3	33960	100.0	3.7	22230	100.0

extra nitrogen in manure. However, in the absence of manure, the yield was generally lower.

The yields of the urea plots were well above the average of the rest of the nitrogen plots. Urea is the most concentrated nitrogen fertilizer on the market analyzing 46 per cent available nitrogen.

PLANT PATHOLOGY

Effect of Fungicides on Plants—(*Adams Fund*)

Experiments have been continued in which the effect of increasing the percentages of lime in Bordeaux mixture on injury produced have been studied. In the case of the apple, and using 1 per cent Bordeaux mixtures in which the ratio copper to lime was 1:0:2; 1: alkalinity; 1:1; 1:2; 1:4; and 1:6; O. Butler finds that on the fruit the injury produced is about equally intense at all ratios up to and including 1:2 but becomes negligible at a ratio of 1:4 and above. The foliage of the apple is less sensitive to copper injury than the fruit, but again some injury is still produced when a mixture containing a ratio of copper sulphate to lime of 1:2 is employed. A ratio of 1:4 causes no injury. The peach was found to be more sensitive than the apple, and a ratio of copper sulphate to lime of 1:6 was found necessary to prevent all injury.

Apple Scab—(*Hatch Fund*)

Once scab has been thoroughly controlled in a McIntosh orchard, is it possible to reduce the number of sprayings given from three to two? To answer this question, one plot was sprayed by O. Butler with lime-sulphur 1-50 at the pre-pink and calyx stages and another at the pre-pink, pink and calyx stages. In the plot sprayed twice, scab lesions on the fruit were noticeable; but in the plot sprayed three times the scab lesions were small and would have passed unperceived unless looked for. The per cent of scab found was as follows:

Lime-sulphur 1-50 pre-pink and calyx	13.78
Lime-sulphur 1-50 pre-pink, pink and calyx	5.00

It was also found, in confirmation of a previous experiment, that when a 2-2-50 Bordeaux mixture was used for the pre-pink and pink sprays and lime-sulphur 1-50 for the calyx spray, the scab control obtained was better than that given by 1-50 lime-sulphur solution used for all three sprayings, and equal to lime-sulphur solution 1-50 used as pre-pink, pink, calyx and 14 days after the calyx spray.

Bitter-Pit of Apple—(*Hatch Fund*)

In 1925 a large number of check trees in this experiment bore no fruit, and the data obtained were therefore fragmentary. In 1924 complete data were secured in all the plots, and fertilization taken as a whole was found beneficial in 0.6 of the cases; in 1925, to consider the plots furnishing complete data only, fertilization was beneficial in only 0.4 of the cases. In both 1924 and 1925, however, the plots fertilized

with phosphoric acid, phosphoric acid and potash, and phosphoric acid, potash and lime, produced fruit freer from bitter-pit than did the check plots. In 1924 the fruit borne in nitrogen and lime, and nitrogen and potash plots was freer from bitter-pit than that borne in the check plots; but in 1925 this condition was reversed. In 1924 and 1925 the potash, and potash-plus-lime plots produced fruit freer from bitter-pit than did the check plots.

RURAL ECONOMICS

State-Wide Consumption Survey—*(Purnell Fund)*

The preliminary state survey of the purchases of farm commodities by stores, hotels and camps was begun in August, 1925, in co-operation with the Bureau of Agricultural Economics of the United States Department of Agriculture. Approximately 1250 store and 300 hotel records were taken. The purpose of this study was to secure definite information as to quantities of farm products which were being shipped into the state at various seasons of the year. Special emphasis was given to those bulky or perishable products that are being shipped in during that season of the year when local products could be grown. In most instances, no attempt was made to decide whether or not these commodities could be profitably grown locally. More detailed commodity studies later can more adequately answer these problems.

The outstanding results of the survey, which was made by H. C. Woodworth, L. B. Lincoln and H. I. Richards, are:

1. About 300,000 bushels of potatoes are shipped in during the competing season.
2. The local markets are nearly supplied by local production with beets, carrots, parsnips, greens, string beans, tomatoes and cucumbers, during the competing season. (This is an important fact since an increase in production would mean a local surplus and prices would be low.)
3. Hotels in the White Mountains buy most of their vegetables outside of the state.
4. Hotel demand for poultry and eggs in the White Mountains is much greater than the local production.

The results of the survey were published in Station Bulletin No. 222, "Can New Hampshire Produce More of What She Eats?"

As the result of the facts brought out in this preliminary survey, definite projects for more detailed study have been started, as follows: a study of potato production; study of vegetable demand in the White Mountain district and the methods of supplying the demand; study of poultry demand in the White Mountain district, and the methods of supplying the demand.

Cost of Fruit Study—*(Purnell Fund)*

In co-operation with the Bureau of Agricultural Economics, U. S. Department of Agriculture, a detailed study of cost of producing apples was undertaken in April, 1926. Twelve farms were selected and

organized into a cost route study by H. C. Woodworth, G. F. Potter, and H. A. Rollins. Financial and daily labor records worked out by the Bureau of Economics for cost route studies elsewhere, are being kept on the farms.

At the end of the fiscal year this project had been under way only about two months. The farmers were keeping the records up to date. Some difficulty was experienced at first in getting definite details as to the kind of work done, but the men now have a better understanding of what is needed and are cooperating splendidly.

Commercial Apple Orchard Survey—(*Purnell Fund*)

Work on the apple orchard survey was completed during the year by G. F. Potter and H. A. Rollins, and the results have been published in Bulletin 223. This work indicates that there will be a material increase in fruit production in New Hampshire during the next ten to fifteen years. Definite recommendations can be made in view of this situation as to methods of production and marketing which it is believed should be adopted by fruit growers in this section.

The survey also points out a probable 300 per cent increase in the crop of McIntosh. This means that problems in relation to handling and storing of this rather tender variety will be acute at an early date. It is hoped that the equipment will soon be available so that investigations on these problems may be started at this station.

RURAL ELECTRICITY

Relation of Electricity to Agriculture—(*Miscellaneous Income Fund*)

This project, which is carried on in cooperation with the National and State Committees on the Relation of Electricity to Agriculture, is of such importance that a separate report on the progress of the past year is to be published. Data have been secured regularly during the year by W. T. Ackerman on the seven experimental farms selected in the state. They include tests on household ranges, dishwashers, water pumps, hot water heaters, bottle washers, household refrigerators, clothes washers, milking machines, cream separators, milk-cooling water pumps, dairy refrigerators, battery chargers, silo cutters and blowers, hay fork hoists, fertilizer mixers, portable chore motors, ironing machines, yard search lights, fertilizer grinders, poultry lights, drinking fountains and fountain heaters for poultry, electric brooders, grain and feed mixers, grain elevators, violet ray equipment, electric incubators, poultry pen cleaning equipment, apple graders and sorters.

SOILS

Soil Fertility Studies—(*Purnell Fund*)

Five different types of experiments are being conducted under this main heading by F. S. Prince, and T. G. Phillips.

1. Effect of Manure, Fertilizers and Lime on Worn-Out Hay Lands

A portion of the field on the Whenal farm at Greenland, N. H., leased for experimental purposes in 1925, was plowed, prepared, and

seeded in August and September, 1925, to timothy. A portion of the old sod, comprising 12 plots, was left for comparison. Half of these plots were top-dressed in the spring of 1926 with nitrate of soda. The remainder of the experiment, 51 twentieth-acre plots, was seeded with different treatments of lime and manure in 1925 and top-dressed with nitrate and acid phosphate in the spring of 1926, so that a complete series of plots with no lime, two tons lime, four tons lime, no manure, 10 tons manure, nitrate of soda and acid phosphate was laid out. Samples of the surface soil of each plot were taken as well as composite surface and subsoil samples of the series.

Owing to drought or lack of nitrate, or both, no stand was secured on those plots which did not receive manure. The yields in Table XIX, therefore, are for the unplowed and the manured plots.

TABLE XIX—*Yields of hay in pounds per acre in* 1926 *on soil fertility plots*

Treatment	*Yield*
No treatment	379 lbs.
Top-dressed, 100 lbs. nitrate of soda	466 lbs.
Manure, 10 tons	410 lbs.
Manure and acid phosphate, 250 lbs.	402 lbs.
Manure and nitrate of soda, 100 lbs.	772 lbs.
Manure, acid phosphate and nitrate of soda	835 lbs.
No lime	479 lbs.
Lime, 2 tons	637 lbs.
Lime, 4 tons	698 lbs.

The variations in the yields of plots having the same treatment (the experiments are in triplicate) were so wide that it is doubtful if the 1926 figures are of much significance, except that those plots receiving nitrate of soda responded to that chemical and that there is a consistent gain for the use of lime. It is interesting to note that the response for nitrate is much greater on newly seeded plots than on the run-out sod.

The unmanured plots on which no stand was secured were reseeded in August, 1926, and nitrate was applied to those plots which should ordinarily receive an application next spring, to see whether the lack of nitrates or some other factor was the cause of no catch of grass.

2. Legume Growing on Worn-Out Land

An experiment with alfalfa and sweet clover on neglected hay lands is also in progress on the Whenal Farm. It involves the seeding of alfalfa directly after plowing with various treatments of manure, lime, nitrate of soda, acid phosphate and potash, and of sweet clover with manure, lime, acid phosphate and potash. As with the hay experiment, samples of the soil of each plot and composite samples of the surface and subsoil of the series were taken for chemical analysis.

The seed was sown for this experiment in June, 1926, and good stands of both crops were secured. There are 48 one-twentieth acre plots in the alfalfa experiment and 32 in sweet clover.

On the alfalfa plots a basic treatment of two tons of ground limestone and twenty loads of manure was used, and the plots were then further treated varyingly with 2 tons of ground limestone, 20 loads of manure, 100 lbs. nitrate, 500 lbs. of acid phosphate, and 150 lbs. muriate of potash in all their combinations. All plots are in triplicate, and one out of every four is a check plot. The alfalfa was seeded June 23, 1926, without a nurse crop, and a good stand was secured.

A basic treatment of 2 tons of ground limestone was used in the sweet clover plots, and the plots were then varyingly treated with 2 tons limestone, 20 loads manure, 500 pounds acid phosphate and 150 pounds muriate of potash alone and in combination. The sweet clover was seeded June 3, and a good stand secured.

3. Effect of Green Manure and Fertilizer on Worn-Out Hay Land

This project, started in 1920 at Durham, involves the reseeding of old hay lands after plowing under green manures and the application of different fertilizers applied at the time of reseeding. There are 40 twentieth-acre plots.

The results for 1926 do not indicate any consistent residual effect of the fertilizers, which were applied in 1923, whereas the average yields for the four years show considerable increase for those plots on which fertilizers were applied. Variations in the yields of individual plots make it difficult to arrive at any definite conclusions.

Averaged according to green manuring treatments in 1926, the results indicate higher yields for the plots having had three green crops turned under and also a better yield for the plots receiving one green crop as against those which were merely plowed and reseeded. It is interesting to note that for the first two years after reseeding the plots which had no green manure outyielded those which had one green crop, while the last two years the results have been reversed.

4. Crop Rotation System

A field has just been leased on the Carter Farm, Boscawen, N. H., upon which a dairy farm rotation system will be installed. The field has been surveyed, and 120 plots have been staked out for experimental purposes.

5. Pasture Improvement through Sweet Clover

Two areas of pasture land on the College farm, one on a good pasture, the other on a very poor pasture, were laid out and divided into four twentieth-acre plots in the spring of 1925. One of these was plowed, all were limed and treated with 500 pounds acid phosphate per acre.

The plowed plots were seeded in May, 1926, and one other plot in each experiment was seeded and disked. One of the remaining plots in each experiment will be seeded in the fall of 1926 with unscarified seed, and the other will be seeded in the late winter of 1927.

This experiment is designed to ascertain how pasture lands can be most easily gotten into sweet clover.

TESTING AND INSPECTION SERVICE

Feed Inspection—(*Miscellaneous Income*)

In connection with the enforcement of the law regulating the sale of concentrated commercial feeding-stuffs, 350 samples of these materials were analyzed for the State Department of Agriculture. About 2800 individual determinations were made by T. G. Phillips, T. O. Smith, S. R. Shimer and A. W. Petre in carrying out these analyses. The results are reported in the annual inspection bulletin.

Fertilizer Inspection—(*Miscellaneous Income*)

One hundred and three samples of commercial fertilizers were also analyzed for the State Department of Agriculture, involving 600 individual determinations.

Seed Inspection Work—(*Miscellaneous Income*)

The station seed laboratory was formally placed on the "certified list" by the Association of Official Seed Analysts in December, 1925. During the 1926 season 409 samples of seed were handled in the laboratory. Of these 369 were official inspection samples secured from seed dealers by the State Department of Agriculture. The remainder were private samples sent in by dealers, county agents, and farmers. The seed inspection work is under the direct supervision of M. G. Eastman with Miss B. I. Glidden serving as assistant analyst.

Advanced Registry Tests—(*Miscellaneous Income*)

Two hundred and sixty cows were entered on the Advanced Registry tests, which were conducted under the supervision of J. M. Fuller. They were divided into the various breeds as follows: Holsteins, 66; Guernseys, 107; Jerseys, 46; Ayrshires, 10; Shorthorns, 8; Devons, 23; Four herds, containing 54 cows, were entered on the Ayrshire herd test. Thirty-one breeders took advantage of the testing work.

Post-Mortem Examinations—(*Miscellaneous Income*)

With the addition of a veterinarian to the staff it has been possible for the institution to do a considerable amount of state service work of this type. During the year, 1667 specimens were examined by E. M. Gildow; most of these were poultry, some few being cattle, dogs, cats, etc. Many specimens showed two or sometimes three specific conditions that were possible causes of the trouble. Consequently the total number of conditions found in the different specimens is greater than the number of specimens themselves. Poultry diagnoses were as follows: ascities, 1; bacillary white diarrhea, 357; blackhead, 15; bronchitis, 9; cannibalism, 8; chicken-pox, 11; coccidiosis, 292; colds, 8; crazy chicks, 23, (a typical condition during the first five weeks of life that has not been associated with any known disease); crop bound, 1; depraved appetite, 14; enteritis, 87; feather mites, 3; gout, 49; heat prostration, 2; lice, 8; limber neck, 1; nephritis, 10; ottorhea, 3; paralysis, 172; peritonitis, 12; pneumonia, 204; rickets, 20; round worms, 44; roup, 7; ruptured yolk sack, 13; septicemia, 48; tape worms, 30;

trauma, 14; tuberculosis avian, 1; tumors, 14; typhoid, fowl, 12; unknown, 31; vent gleet, 4; watery chicks, 8. (The last term refers to chicks that seem to fill the abdominal cavity up with water. The thoracic cavity and subcutaneous tissues are very watery and the chicks appear to be twice their normal size. No definite cause for this condition has been determined.)

Tests for contagious abortion of cattle numbered 129.

White Diarrhea Tests—(*Miscellaneous Income*)

Bacillary white diarrhea testing work was carried on by A. W. Lohman and W. A. Higgins, who tested approximately 37,600 blood samples from birds throughout the state.

Potato Seed Certification—(*Miscellaneous Income*)

Owing in part at least to the narrow margin in price between potato seed and table stock this year, only 46.85 acres of potatoes were entered for certification and 44.85 acres passed the 2nd inspection. The work was conducted by O. Butler and F. R. Clark.

Miscellaneous Tests

Several of the county agents have supplied themselves with equipment for testing soil acidity in the field. As a result only 80 samples of soil were sent in for acidity tests by agents during the year.

Samples of feeds, fertilizers, soils, peat, lime and minerals were sent in by individuals in the state. Of these 42 were analyzed, involving a total of 120 individual determinations.

VETERINARY MEDICINE

Paralysis in Chickens—(*Purnell Fund*)

The possible cause of poultry paralysis, which is generally prevalent in New Hampshire, has been under investigation by E. M. Gildow from the angle that it may be associated with the parasitic disease of coccidiosis. This study has been taken up from four different viewpoints.

1. A practical program was outlined for the prevention of infestation with coccidiosis in growing chickens. In order to determine how successfully this could be accomplished and to determine whether or not birds grown free from coccidiosis would develop paralysis, two lots of chickens were grown. One lot of 200 pullets was grown and matured on a piece of land where coccidiosis and paralysis had existed in poultry the previous year, and 800 pullets were grown and matured on a clean piece of land out of contact with any other source of poultry in so far as was possible. Regardless of the care that was taken, the lot grown on clean land developed coccidiosis to a slight extent during their growing period and subsequently came down in a few instances with paralysis. However, the sum total of all of the paralytic causes in the 800 pullets has not as yet outnumbered those that developed in the 200 pullets on the old piece of land. Therefore, it is safe to assume that whether or not coccidiosis and paralysis are associated, the methods of eliminating coccidiosis evidently reduce the amount of paralysis.

2. If coccidiosis is closely associated with paralysis, it seems that it should be possible to produce paralysis in pullets. Two lots of ten birds each were housed in identical quarters. One lot was fed 1 cc. of a suspension of embryonated coccidia weekly while the other lot was left clean. At the end of two months no definite and unmistakable symptoms of paralysis had developed in the infected pen. At this time the infected pen had lost 1-3 pound per bird; six birds had crooked keel bones, and three had died. They laid 96 eggs. In the clean pen the birds had gained 1-5 of a pound each; only one bird had a crooked keel bone; none had died, and they had laid 163 eggs. There is definite evidence from this that coccidiosis is extremely detrimental to pullets regardless of whether it is associated with paralysis or not.

3. A second practical application based on the life cycle of coccidia was used in a pen trial on pullets that had shown evidence of paralysis before they were housed. Two pens of 125 pullets each were used in this experiment. One pen was cleaned regularly every seven days, and the other pen cleaned once each month. The idea of the trial was to see whether the elimination of the embryonated oocysts from the environment of the hens would reduce the amount of coccidiosis and consequently improve their health. From March 28 to June 23 the pen that was cleaned weekly laid 5,135 eggs as against 4,333 for the pen cleaned once a month. Birds culled and dead in the pen cleaned weekly during that time were 72; and from the pen cleaned once each month were 95. This evidence suggests that coccidiosis may be at the source of some of the trouble in the laying pens.

4. If coccidiosis is the cause of or is associated very extensively with paralysis, it should be possible to control the condition by sanitary measures from what we know of the life cycle of the coccidia. With this in mind, paralytic birds and birds suffering from coccidiosis were placed in coops having a false bottom of one-inch mesh chicken-wire and were fed all mash, scratch and water from containers outside the coup.

From these experiments it was found that the passage of coccidia from an infested bird would cease at about the 13th to 15th day after it was placed in the special coop. However, birds suffering from paralysis seldom recovered sufficiently to regain their strength and weight. Paralytic birds placed in these coops, even though they lived considerably over the two weeks period, necessary for the elimination of the coccidia, seldom recovered. In one instance two White Leghorn pullets that were showing lameness or the loss of the use of one leg were found to be heavily infested with round worms and were treated for round worms with nicotine sulphate while in one of these special coops. Both of these birds recovered their health and gained in weight, and one of them laid quite a few eggs after the treatment. However, neither of them recovered the use of the paralyzed limb.

From these experiments we cannot conclude that coccidiosis is the cause of paralysis or that they are necessarily associated, but the evidence does point to the fact that coccidiosis is an extremely detrimental factor in the production of good healthy stock and that measures outlined to combat or control coccidiosis assist in controlling paralysis also.

Testing Pullets for White Diarrhea—(*Miscellaneous Income*)

Several unsupported statements are made in the literature to the effect that carriers of *S. pullorem* will not in most instances show typical and definite sereological reactions to the agglutination test before they have laid a considerable number of eggs. To determine the facts in this matter, a pen of 125 pullets that had suffered from white diarrhea as chickens was housed and tested by E. M. Gildow at monthly intervals from the 4th month after they were hatched until they were nine months old. During this period reactions to the agglutination test were as follows:

4 months	2 reactors
5 months	4 reactors
6 months	3 reactors
7 months	2 reactors
8 months	1 reactor
9 months	0 reactor

The birds showing reactions were moved after each test; this eliminated the possibility of transmitting the disease from one bird to another. As a point of interest it might be stated that these pullets started laying at 4½ to 5 months of age. The experiment is not yet completed.

Financial Statement New Hampshire Agricultural Experiment Station for the year ending June 30, 1926

	Hatch Fund	Adams Fund	Purnell Fund	Supplementary*	Total
Salaries	$10241.83	$11614.19	$11187.25	$13276.37	$46319.64
Labor	523.04	1687.37	2103.11	3807.76	8121.28
Stationery and office supplies	127.58	54.17	36.67	248.88	467.30
Scientific supplies, consumable	25.28	380.35	199.87	838.54	1444.04
Feeding stuffs	None	455.18	120.66	435.95	1011.79
Sundry supplies	88.07	91.82	129.39	1713.66	2022.94
Fertilizers	245.92	None	395.85	68.21	709.98
Communication service	586.14	5.21	15.10	235.61	842.06
Travel expenses	323.76	43.62	3484.21	2427.38	6278.97
Transportation of things	315.77	19.55	36.17	131.29	502.78
Publications	1322.81	——	727.50	None	2050.31
Heat, light, water & power	700.00	None	13.27	44.54	757.81
Furniture, furnishings, fixtures	69.20	21.70	89.93	2.70	183.53
Library	397.00	None	6.39	124.90	528.29
Scientific equipment	None	181.88	188.34	848.82	1219.04
Livestock	None	None	None	200.00	200.00
Tools, machinery & appliances	14.90	63.03	158.56	629.93	866.42
Buildings and land	18.70	381.93	1087.73	575.78	2064.14
Contingent expenses	None	None	20.00	122.20	142.20
Balance	None	None	None	3284.79	3284.79
TOTAL	$15000.00	$15000.00	$20000.00	$29017.31	$79017.31

* This fund includes income from the following sources:

State appropriations	$4500.00
Sales	1527.29
Miscellaneous	22990.02
	$29017.31

STATION STAFF

J. C. Kendall, B. S., *Director*
F. W. Taylor, B. S. (Agr.) *Agronomist*
W. C. O'Kane, A. M., *Entomologist*
O. R. Butler, Ph. D., *Botanist*
J. C. McNutt, B. S., (Agr.) *Animal Husbandman*
E. G. Ritzman, B. S., *Research Professor in Animal Husbandry*
K. W. Woodward, A. B., M. F., *Forester*
J. M. Fuller, B. S., *Dairy Husbandman*
A. W. Richardson, B. S., *Poultry Husbandman*
G. F. Potter, M. S., *Horticulturist*
T. G. Phillips, Ph. D., *Chemist*
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Stuart Dunn, M. S., *Assistant Botanist*
A. W. Lohman, M. S., *Assistant Poultryman*
W. A. Higgins, B. S., *Assistant Poultryman*
L. R. Tucker, B. S., *Graduate Assistant in Horticulture*

ASSISTANTS TO THE STAFF

H. B. Stevens, A. B., *Executive Secretary*
W. P. Lewis, B. L. S., M. A., *Librarian*
Raymond C. Magrath, *Business Secretary*
Beatrice M. Richmond, *Bookkeeper*
Elizabeth E. Mehaffey, *Assistant Librarian and Mailing Clerk*
Christina M. Collins, *Stenographer*
Helen M. Hilton, *Stenographer*
Mary E. Lawless, *Stenographer*
Muriel E. Murray, *Stenographer*
Jean Edmundson, *Stenographer*
Elizabeth Rowe, *Stenographer*
Margaret Symes, *Stenographer*